Development of E-Modules Based on Project-Based Learning on Tapper Turning Materials

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Abstract. This study aims to develop an electronic module (E-Module) based on Project Based Learning which will be applied to the tapper turning material. The development of this e-module is carried out as a means to complement the availability of teaching materials used during the implementation of hybrid learning. This research is development research conducted with the Four-D Model development model which consists of four stages, namely Define, Design, Develop, and Disseminate. The instruments used to collect data are the feasibility test sheets for material experts and media experts, as well as test instruments to determine the practical evaluation by students. The developed e-module has been validated using a Likert scale on aspects of content feasibility, language feasibility, presentation feasibility, and graphic feasibility. The results of the study show that the e-module based on the project learning developed is very feasible and practical to be used in learning Lathe Machining Practice I, especially in the material of tape turning. This can be seen from the results of the material expert validation with a percentage score of 83.02% or in the very feasible category, as well as the media expert validation score of 83.5% also in the very feasible category. In addition, the results of the practicality assessment by students obtained a score of 80% or practical for use in learning.

Keywords: development · e-module · project-based learning · tapper turning

1 Introduction

Learning is an effort that involves internal and external factors that are carried out so that the learning process occurs in each student [1]. Another understanding of learning is the activity that contains interactions between educators, students, and various kinds of learning resources in a learning environment [2]. Meanwhile, Hamalik [3] states that learning is a combination of various elements consisting of humans, materials, facilities, equipment, and procedures that influence each other to achieve learning objectives. From these various opinions, it can be concluded that learning is a process of communication and interaction between educators and students who are supported by various kinds of media and elements that influence each other, to achieve learning objectives.

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The Mechanical Engineering Education Study Program (PTM) is one of the study programs in the engineering faculty of the State University of Semarang. The learning carried out in the PTM Study Program consists of theoretical and practical learning. One of the courses carried out in practice is Lathe Machining Practice I. In this course, the materials taught include sharpening lathe chisels, flat and graded turning, tapered turning, groove turning, and outer thread turning. Based on the results of observations and interviews with students, one of the materials that are difficult to understand is the material for turning tapered. This is due to the additional machining parameters they have to learn and the lack of adequate student learning resources for the material.

To overcome these shortcomings, one of the efforts that can be done by lecturers is to practice using the Project Based Learning method. Project-based learning is a learning model that emphasizes students as the main actors in learning in solving learning problems through a given project [4]. Another opinion revealed that project-based learning is learning that emphasizes the activities of exploring creative thinking, problem-solving, and students' communication skills [5]. Meanwhile, according to Patton [6], project-based learning is a learning activity carried out starting from design, planning, and implementation, to the production of a product as learning output that can be published.

As a means to complement problem-based learning methods, lecturers as educators need to make certain efforts so that they can achieve the learning objectives formulated in the curriculum. The challenges and demands of an educator today have increased, and to meet the demands of the curriculum an innovative educator is needed in developing the learning process [7]. This can happen as a result of the rapid development of science and technology, not least in the world of education. So that currently various kinds of technology are also applied to facilitate educators and students in carrying out learning. One of the efforts that can be made by lecturers to take advantage of technological developments in the world of education is to apply technology-based learning media [8–10]. Gerlach and Ely [11] suggest that the media are various objects consisting of humans, materials, and events that can be used to obtain information, knowledge, skills, and attitudes. In addition, according to the opinion of Paor [12] that an educator must develop their ability to teach practice through the use of ICT to conduct learning and assessment. Based on some of these opinions, a lecturer as an educator needs to develop technology-based learning media to increase student participation and learning outcomes.

One of the technology-based learning media that can be used in practical learning is an electronic module or e-module. E-modules are modules that are specially designed without being printed and can be used by students for independent study [13]. E-module is one of the modules based on information and communication technology so that it can be an interactive media, easy to use, can be equipped with pictures, audio, video, and animation, and can be filled with formative tests that can be done directly by students. [14]. The e-module that is presented electronically, will make students more interactive in learning [15].

Based on this background, the purpose of this research is to develop an e-module on taper-turning material. The e-module referred to in this study is a digital module that contains material for turning tapered which is equipped with pictures, animations, and videos of how to turn tapered for various types of lathe works. The resulting e-module is expected to be declared valid by material experts and media experts so that it is suitable

for use in learning. After being declared valid and feasible by material experts and media experts, the practicality of using the e-module will be measured through the opinions of students.

2 Research Methods

This research uses the development method. A development research method is a research method to produce a product to test the effectiveness of the product [16]. The development method adopted in this study is the Four-D Model development model which consists of four stages, namely Define, Design, Develop, and Disseminate [17].

At the stage of defining the activities carried out is lecture analysis, including analysis of semester learning plans (RPS), learning outcomes, student characteristics, and learning objectives. Next, at the design stage, the activities carried out are compiling an outline of the contents of the e-module, determining the writing format, writing the script, and editing the script.

After completing the design stage, then proceed to the development stage. At this stage, the e-module that has been designed initially is then tested by material experts and media experts. Following the results of the validation, the next revision of the e-module was made so that it was feasible to be tested on students. The last stage is dissemination. At this stage, the revised and tested e-module is then distributed in a limited way to lecturers and students who are the research subjects.

The data collected in this study consisted of qualitative data and quantitative data. Qualitative data were obtained from suggestions and revisions of e-modules provided by material experts and media experts. While quantitative data were obtained from the scores given in the validation instrument of material experts and media experts. In addition, quantitative data was also obtained from the results of the e-module assessment when it was distributed to students and lecturers.

To collect these data, this study used the methods of observation, interviews, and questionnaires. Observation and interview methods were used in the early stages of development, namely the collection of curriculum data, lesson plans, learning outcomes, learning objectives, and student characteristics. While the questionnaire method was used to obtain validation data from material experts, media experts, and a feasibility questionnaire by students. The questionnaire has a scoring method on a Likert scale with the provisions as in Table 1.

Table 1. Guidelines for scoring by the validator

Rating	Description	Score
SS	Strongly Agree	4
S	Agree	3
TS	Disagree	2
STS	Strongly Disagree	1

Table 2. Criteria for the percentage of eligibility and practicality

Percentage	Classification
81%–100%	Very feasible/very practical
61%–80%	Eligible/practical
41%–60%	Fairly feasible/quite practical
21%–40%	Less feasible/less practical
0%–20%	Not feasible/not practical

After the research data was obtained, then data analysis was carried out. The first analysis uses the percentage method to assess the feasibility of the developed e-module which is calculated using the formula below [16].

$$Percentage(\%) = \frac{\text{observation score}}{\text{expected score}} \times 100\% \quad (1)$$

The percentage data that has been obtained is then converted into qualitative data. The qualitative data in question is a statement that represents the rating scale to indicate the feasibility level of the developed e-module. The eligibility categories can be seen in Table 2.

3 Results and Discussion

3.1 Define Stage

At this stage of defining, the initial activities carried out were observing the implementation of Lathe Machining I practice learning. The first step the writer did was to analyze the curriculum, learning outcomes, learning objectives, and lesson plans. In addition, the author also conducted non-structured interviews with lecturers and students taking the Lathe Machining Practice I course. This interview was used to determine the current learning conditions.

Based on the results of these observations and interviews, information was obtained that there was still a lack of practice modules as supporting courses for students, especially in the material for turning tape. The current module is a print module. The module has explained various kinds of work on a lathe, but only in outline so that students have difficulty learning the details of these materials, one of which is the tape turning process. Other information obtained is that there is still a lack of assessment components in existing modules so lecturers and students do not yet have standard guidelines regarding the assessment of learning outcomes. In addition, the existing print modules are not stored properly, making it difficult for students to access the module.

The existence of the developed e-module is expected to overcome these existing limitations. The use of this e-module is expected to provide an experience for students to learn independently about the material being studied. In addition, it will be able to increase their self-efficacy, self-reaction, motivation to learn, and the acquisition of lifelong learning strategies [18].

3.2 Design Stage

At the design stage, the activities carried out are designing the contents of the e-module which includes the activities of compiling an outline of the contents of the e-module, selecting the writing format, writing the script, and editing the e-module script. The material presented in this e-module begins with an introduction that contains a description of the e-module, prerequisites, instructions for use for students and lecturers, learning objectives, final competencies, and a check of students' initial abilities. The second part contains learning materials consisting of student learning activity plans, learning objectives, material descriptions, summaries, student assignments, formative tests, worksheets, and answer keys. In detail, the material presented in this second part includes general work using lathes, tapered lathes, tapered lathe equipment, machine calculation parameters for tapered lathes, and tape lathe work steps.

The third section contains evaluations used to measure student abilities in the cognitive, attitudes, skills, product assessments, answer keys, and ends with a bibliography used in the e-module. The writing format is made consistently in the same order. Furthermore, the e-module script is made in pdf format which is then transferred in the form of an application (.exe) with the help of the 3D Pageflip Professional application.

3.3 Development Stage

The e-module development stage contains validation activities by material experts and media experts. This study involved two media experts and two material experts as validators. Each validator is asked to conduct an e-module assessment according to the previously given instrument. In addition, suggestions from validators are also collected as material to improve the developed e-module.

The data in Table 3 shows the results of validation by material experts. The aspects assessed by the material expert include the feasibility of the content, the feasibility of presentation, the language used, and the benefits that can be obtained from the developed e-module. In the aspect of content feasibility, an average score of 13 is obtained from a maximum score of 16, so the percentage of the resulting assessment is 81.25% or is in the very feasible category. Furthermore, in the aspect of display feasibility, the average score obtained is 14 out of a maximum score of 16. So it produces a feasibility percentage of 87.5% (very feasible). Aspects of language assessment get a percentage of 80% (decent), which is obtained from the average score of 16 out of 20 maximum scores. Next, on the aspect of usefulness, a percentage of 83.3 (very feasible) was obtained with a score of 10 out of a maximum of 12. Based on the results of the material expert's assessment, the e-module was declared very feasible to be used in learning with an average percentage of 83.02%.

In addition to providing assessments in the form of scores, material expert validators also provide suggestions for improving the e-module. The advice given is related to Occupational Health and Safety material that needs to be added to the e-module, and the addition of theory about various types of lathe cutter.

In addition to validation by material experts, e-module validation is also carried out by media experts. Media expert validators assess aspects of writing format, ease of use, consistency of writing, and the overall appearance of the developed e-module. In the

Table 3. Results of material expert validation

Assessment Aspects	Obtained Score	Maximum Score	Percentage (%)
Contents Eligibility	13	16	81.25
Display Eligibility	14	16	87.5
Language Eligibility	16	20	80
Benefit	10	12	83.3
Average			83.02

Table 4. Results of media expert validation

Assessment Aspects	Obtained Score	Maximum Score	Percentage (%)
Format	7	8	87.5
Ease of use	10	12	83.3
Consistency	10	12	83.3
Display	16	20	80
Average			83.5

aspect of writing format, an average score of 7 was obtained from a maximum score of 8. The score resulted in a feasibility percentage of 87.5% or very feasible. Aspects of ease of use and consistency of writing obtained the same results, namely the average score of 10 out of a maximum score of 12 with a percentage of 83.3% or very feasible. While the display aspect gets a score of 16 from a maximum score of 20, resulting in a percentage of 80% or feasible. From these four aspects, the average percentage of media expert validation is 83.5% or the e-module is declared very feasible to be used in learning (Table 4).

The advice given by media experts is related to the use of fonts and font sizes that need to be adapted to the use of digital media. In addition, there are still many images that need to be updated from the latest sources or with photos of machines in the machining workshop, so that they are clearer and more up-to-date.

The feasibility test of this e-module is of course very important before being used by students. With the e-module, it will be easier for students to access the e-module from anywhere and anytime. In addition, the existence of e-modules that are applied to project-based learning will help students learn independently and share information [19].

After being declared eligible for use in learning by material experts and media experts, then the e-module was tested on students. This trial aims to assess students' perceptions of the practicality of the developed e-module. This trial involved 42 students who took the Mechanical Practice I course. The test results showed an average percentage of the practicality of 80% or included in the practical category. The use of this e-module will make it easier for students to learn it because it can be accessed via smartphones or

laptops so it is more practical [20]. The existence of the e-module also makes it easier for students to access learning resources wherever and whenever needed.

3.4 Dissemination Stage

The developed e-module has been declared feasible by material experts and media experts, and it has also been declared practical based on the results of testing for students. The next step taken by the researcher is to distribute the developed e-module. However, the distribution of this e-module is still limited to students and lecturers in the Mechanical Engineering Education study program. This is done because students from other study programs have not taken these subjects, so the distribution is adjusted to the current learning needs.

4 Conclusion

Based on the results of the research and discussion, it can be concluded that the e-module based on the development of project learning is very feasible and practical to be used in learning Lathe Machining Practice I, especially in the material of tape turning. This can be seen from the results of material expert validation with a percentage score of 83.02% or in the very feasible category, as well as a media expert validation score of 83.5% also in the very feasible category. In addition, the results of the practicality assessment by students obtained a score of 80% or practical for use in learning. However, further research still needs to be done to determine the effectiveness of the developed e-module in improving student learning outcomes in the material for tape-turning practice.

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